

TRMM and its connection to the Global Water Cycle

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The importance of quantitative knowledge of tropical rainfall, its associated latent heating and variability is summarized in the context of the global hydrologic cycle. Much of the tropics is covered by oceans. What land exists, is covered largely by rainforests that are only thinly populated. The only way to adequately measure the global tropical rainfall for climate and general circulation models is from space. The TRMM orbit is inclined 35° leading to good sampling in the tropics and a rapid precession to study the diurnal cycle of precipitation. The precipitation instrument complement consists of the first rain radar to be flown in space (PR), a multi-channel passive microwave sensor (TMI) and a five-channel VIS/IR (VIRS) sensor. The precipitation radar operates at a frequency of 13.6 GHz. The swath width is 220 km, with a horizontal resolution of 4 km and the vertical resolution of 250 m. The minimum detectable signal from the precipitation radar has been measured at 17 dBZ. The TMI instrument is designed similar to the SSM/I with two important changes. The 22.235 GHz water vapor absorption channel of the SSM/I was moved to 21.3 GHz in order to avoid saturation in the tropics and 10.7 GHz V&H polarized channels were added to expand the dynamic range of rainfall estimates. The resolution of the TMI varies from 4.6 km at 85 GHz to 36 km at 10.7 GHz. The visible and infrared sensor (VIRS) measures radiation at 0.63, 1.6, 3.75, 10.8 and 12.0 microns. The spatial resolution of all five VIRS channels is 2 km at nadir. In addition to the three primary rainfall instruments, TRMM will also carry a Lightning Imaging Sensor (LIS) and a Clouds and the Earth's Radiant Energy System (CERES) instrument.

This presentation will focus primarily on the advances in our understanding of tropical rain systems needed to interpret the TRMM data. Global averages, as well as case studies from TRMM radar (PR), the TRMM Microwave Imager (TMI) and Visible and Infrared Sensor (VIRS) will be presented. Comparisons and contrasts among the different sensors will be drawn. Results will also be compared to previous rainfall climatologies generated from the SSM/I instrument. In particular this paper will focus on the synergy between the TRMM radar and passive microwave radiometer and what we have learned from is synergy.

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Clate K. Loomis Aug. 3, 1999
Signature Date

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Signature

Date

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1/8/1999

To: Christian.D.Kummerow.1@gsfc.nasa.gov
From: Jim Frost <jimfrost@pop200.gsfc.nasa.gov>
Subject: Presentation/Publication Request
Cc:
Bcc:
Attached: C:\oldsystem\DOC\bestand_final.doc;

Reference(s): TRMM and it's connection to the Global Water Cycle

Christian,

This morning I received your request(s) on a NASA 1676 form (NASA Scientific and Technical Document Availability Authorization (DAA)) for export control approval on the above referenced paper(s) intended for public disclosure. As these paper(s) provide specific technical information related to spacecraft technology and/or related instruments, disclosing this technology would fall under the jurisdiction of the U.S. State Department, International Traffic In Arms Regulations (ITAR). As such, I would like you to review and if appropriate, sign the applicable exemption on the attached NASA STI Public Disclosure (Export Control) Checklist. We are confident that this checklist, as a replacement for the "draft" Public Domain Declaration will better share the concerns of the GSFC Export Control office, and will lead to more expedient Export Control approvals for GSFC Technical Documents in the near future.

Thanks for your assistance on your presentation. The Export Control office fax number is X6-1774, if you would prefer to fax a response back in lieu of responding via e-mail.

Thanks,

Jim Frost

中 国 气 象 局**CHINA METEOROLOGICAL ADMINISTRATION**

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AN OFFICIAL LETTER OF INVITATION

ATTN: DR. WILLIAM K.M. LAU
DR. CHESTER JOHN KOBLINSKY
NASA GODDARD SPACE FLIGHT CENTER
PASSPORT NUMBER: 801023834
USA

YOU ARE KINDLY EXPECTED BY THE CHINA METEOROLOGICAL ADMINISTRATION (CMA) TO COME TO CHINA AROUND 20 SEPTEMBER 1999 FOR ATTENDING THE PRC-USA CLIMATE SYMPOSIUM AND WORKSHOP TO BE HELD FROM 21 - 24 SEPTEMBER 1999 IN BEIJING. THE DURATION OF YOUR STAY IN CHINA WILL BE ABOUT 10 DAYS. PLS APPLY FORTHWITH FOR A SINGLE ENTRY VISA AT THE CHINESE EMBASSY OR A CONSULATE-GENERAL IN THE UNITED STATES OF AMERICA WITH THIS LETTER IN FAX FORM.

DEPARTMENT OF INTERNATIONAL AFFAIRS
CHINA METEOROLOGICAL ADMINISTRATION

(0128)

JULY 23, 1999, BEIJING

U.S.-China Symposium and Workshop on Climate Variability

Introduction

On September 21-24, 1999 the National Oceanic and Atmospheric Administration will co-host the U.S.-China Symposium and Workshop on seasonal-to-interannual¹ climate variability in Beijing, China. The symposium, entitled Climate, Environmental Change and Regional Impacts, will be held September 21-22 and is being co-hosted with the Chinese Meteorological Agency (CMA). The workshop, entitled Impacts of Ocean Variability on Climate Change, will be co-hosted by the Chinese State Oceanic Administration (SOA) on September 23-24. Dr. D. James Baker, Under Secretary for Oceans and Atmosphere will lead the thirty-member U.S. delegation comprised of high-level managers, scientists, and support staff (U.S. delegation attached). Also on the agenda are commemorations of the twentieth anniversary of both the bilateral Atmospheric Science and Technology Protocol and the Marine and Fishery Science and Technology Protocol NOAA administers on behalf of the U.S. Government.

Rationale

Climate events, such as the 1997/98 El Nino event, have significant human and economic impacts in both the United States and China. In northeastern China, El Nino-driven floods caused more than 4,000 deaths and left millions homeless². In North America, El Nino affected more than 30 million acres of farmland and caused more than \$7 billion dollars in direct economic losses³. Although losses in both countries were mitigated somewhat by recent improvements in climate forecasting, the potential benefits of improved seasonal-to-interannual climate forecasting capabilities and services remain significant. Continued progress in this area will require scientists and managers in China and the U.S. to improve international coordination for sharing data and expertise in order to better understand climate prediction and provide useful climate forecast products.

The following are reasons for having a bilateral workshop on seasonal-to-interannual climate prediction:

- Potential benefits of improved climate forecasts are significant for both the U.S. and China
- Climate variability is a natural, global phenomena and is not localized to any single nation
- The U.S. and China control critical geographic and scientific data that are important for continued improvement of climate forecasts
- China's inability to effectively manage societal strains due to extreme environmental events could increase political instability in Asia

¹ On a time scale ranging from several months to a few years

² Xinhua News Agency

³ "An Experiment in the Application of Global Forecasts: NOAA-OGP Activities Related to the 1997-98 El Nino Event," NOAA, Office of Global Programs, January 1999

- China's growing investments in climate prediction infrastructure could be improved by U.S. input and could provide benefits to climate services in America.

Climate Symposium/Workshop Goals

The symposium and workshop will assemble an interdisciplinary group of scientific experts and high-level administrators from both the U.S. and China to discuss seasonal-to-interannual climate variability, societal impacts, forecasting capabilities (including environmental observation networks and numerical modeling), as well as programmatic management and planning issues. These meetings will set the foundation for improved communication and coordination of national climate programs between the U.S. and China. The agenda (attached) seeks to align China's developing climate program with U.S. program planning and needs.

U.S. Goals

The goal for the U.S. is to improve coordination and communication among major climate players in the U.S. and China and to promote progress in both countries to provide seasonal-to-interannual climate forecasting services. Specifically we would like to:

- Improve U.S. access to Chinese climate data;
- Define and promote China's role in Pacific and Indian Ocean observations;
- Develop a co-laboratory partnership to improve climate modeling and forecasting;
- Develop a joint US-China study to quantify the potential socio-economic impacts of improved climate forecasting.

Government agencies from China represented at these meetings control critical human and fiscal resources as well as programmatic and geographic jurisdictions within China. We have confirmed participation from the China Meteorological Administration, State Oceanic Administration, and the Chinese Academy of Sciences.

Products

These activities contribute to the definition of issues within the "strategic partnership" between the U.S. and China called for by President Clinton. They also support the Vice President's dialogue with China on environment and development. Results from these meetings will be transmitted to the U.S.-China Science and Technology Agreement protocols in Atmospheric Science and Marine and Fisheries Science as well as to the U.S.-China Forum on Environment and Development, co-chaired by Vice-President Gore and Chinese Premier Zhu Rongji.

For more information, contact Rene Eppi, Director, International Activities, Office of Oceanic and Atmospheric Research, NOAA, (301) 713-2469, ext. 132

SYMPOSIUM ON CLIMATE, ENVIRONMENTAL CHANGE AND REGIONAL IMPACTS

NOAA and CMA

As of 7/16/99

September 21 (Tuesday)

Welcome and Opening Remarks

- NOAA and CMA Administrators

D. James Baker
Wen Kegang

Keynote Address

- Tentative

(Tom Malone)

National Climate Program Overview in US and China

- Two US and two Chinese speakers
- Open discussion
- US speakers:

David Battisti
John Roads

Lunch

Theory and Processes

- Two U.S. and two Chinese speakers
- Open discussion
- US speakers:

Kevin Trenberth
Bin Wang

Modeling and Prediction

- Two U.S. and two Chinese speakers
- Open discussion
- US speakers:

Steve Zebiak
Ants Leetma

September 22 (Wednesday)

Impact Assessments and Applications

- Two US and two Chinese speakers
- Open discussion
- US speakers:
- "Climate Change and Regional/Urban Air Quality:
Their Interrelations"

Roger Pielke Jr.
James Meagher

Observations and Data Set Generation and Assimilation

- Two US and two Chinese speakers
- Open discussion
- US speakers:

Tom Peterson
Chester Koblinsky

September 22 (Wednesday) continued

Special Presentation on TRMM

Christ Kummerow

Lunch

Special Topic: Virtual Co-laboratory Concept

- How might research be done collaboratively using the Internet? Len Pietrafesa
Ming Ji
(Nancy Soreide)

General Open Discussion and Review

- Led by U.S. and Chinese co-chairs Ants Leetma
- Highlighted discussion on topics to be agreed upon in summer

Conclusion

Dr. Baker
Wen Kegang

Banquet Dinner

U.S-SINO WORKSHOP: IMPACTS OF OCEAN VARIABILITY ON CLIMATE

NOAA and SOA

As of 7/16/99

September 23 (Thursday)**Morning:*****20th Anniversary of Marine and Fishery Science and Technology Protocol***

- Dr. Baker and SOA Administrator give speeches (20 minutes each)
- Key U.S. and Chinese scientists speak (10 minutes each)
- Other brief speeches (5 minutes each)
- Poster exhibition

Afternoon:***Welcome and Opening Remarks***

- SOA and NOAA Administrators

D. James Baker
Zhang Dengyi***Oceans as Drivers of Climate Variability***

- One U.S. speaker and one Chinese speaker
- US speaker:

Jim O'Brien

Ocean Monitoring & Application of Satellite Remote Sensing Data

- One U.S. speaker and one Chinese speaker
- Q&A
- US speaker:
- Possible second speaker on Application of Remote Sensing Data

Mike McPhaden

September 24 (Friday)***Prediction Modeling and Real Time Forecasting***

- One U.S. speaker and one Chinese speaker
- Q&A
- US speaker:

Ming Ji

Theoretical Study on the Interaction of Monsoon and El Nino

- One US speaker and one Chinese speaker
- Q&A
- US speaker:

Bill Lau

Lunch

Impact of Ocean Variability on U.S. and China Climate and Natural Disasters

- One U.S. speaker and one Chinese speaker
- Q&A
- US speaker:

Chet Ropolewski

Special Topic: Global Ocean Observations – The Next 20 Years

- GODAE/ARGO

TBC

General Discussion and Review

- Led by U.S. and Chinese Co-Chairs
- Highlighted discussion topics to be agreed upon in summer

Stan Wilson

Conclusion

- SOA Deputy Admin. and Chair M&F

Dave Evans
(Chen Lianzheng)

Banquet Dinner

Confirmed NOAA Participants
U.S.-China Climate Meetings
As of 7/16/99

D. James Baker – Administrator, Under Secretary of Commerce for Oceans and Atmosphere

William Bolhofer – Meteorologist, International Activities Office, National Weather Service

James L. Buizer – Assistant Director Research Applications, Office of Global Programs, Office of Oceanic and Atmospheric Research

Charles (Bud) Ehler – Director, International Program Office, National Ocean Service

Rene Eppi – Director, International Activities, Office of Oceanic and Atmospheric Research

David L. Evans – Assistant Administrator for Oceanic and Atmospheric Research

Henry R. Frey – Director, National Ocean Data Center, National Environmental Satellite, Data, & Information Service

Susan B. Fruchter – Director, Office of Policy and Strategic Planning

Ming Ji – Physical Scientist, National Weather Service, Office of Oceanic and Atmospheric Research

Jonathan Justi – Team Leader Asia Programs, National Ocean Service

Jack Kelly – Assistant Administrator for Weather Services

Kenneth Lamon – Program Manager, International Activities, Office of Oceanic and Atmospheric Research

Ants Leetmaa – Director, Climate Prediction Center, National Weather Service

James F. Meagher – Atmospheric Scientist, NOAA Aeronomy Laboratory, Boulder, Colorado

Carolyn C. McMahon – Administrative Officer, International Office, National Weather Service

Michael J. McPhaden – Senior Research Scientist, Pacific Marine Environmental Lab., Office of Oceanic and Atmospheric Research

Thomas C. Peterson – Climatologist, National Climatic Data Center

Steve Piotrowicz – Oceanographer, Office of Oceanic and Atmospheric Research

Julian Wang – Climatologist, Air Resources Laboratory

Pai-Yei Whung – Atmospheric Scientist, Air Resources Laboratory

Stanley W. Wilson – Deputy Chief Scientist, Office of the Chief Scientist

Other Confirmed US Participants
U.S.-China Climate Meetings
As of 7/16/99

David S. Battisti – Associate Professor of Atmospheric Sciences, University of Washington

James J. O'Brien – Professor of Meteorology & Oceanography, Center for Ocean-Atmospheric Prediction Studies, Florida State University

David Festa – Senior Policy Advisor to the Secretary, Department of Commerce

Chester J. Koblinsky – Goddard Space Flight Center, National Aeronautical and Space Administration

Christian Kummerow – Project Scientist - Tropical Rainfall Measuring Mission, Goddard Space Flight Center, National Aeronautical and Space Administration

William Lau – Head, Climate and Radiation Branch, National Aeronautical and Space Administration, National Aeronautical and Space Administration

Thomas F. Malone – University Distinguished Scholar, North Carolina State University

Roger A. Pielke Jr. – Scientist, Environmental and Societal Impacts Assessments Group, National Center of Atmospheric Research

Len Pietrafesa – Head of Marine, Earth, and Atmospheric Sciences Department, North Carolina University

John Roads – Meteorologist, Scripps Institution of Oceanography, University of California, San Diego

Kevin Trenberth – Head, Climate Analysis Section, National Center for Atmospheric Research, Mesa Laboratory

Bin Wang – Professor of Meteorology, University of Hawaii

Lian Xie – Assistant Professor and Coordinator, North Carolina State University-University of North Carolina Wilmington, Department of Marine, Earth and Atmospheric Sciences

Stephen E. Zebiak – Director, Modeling Research Division, International Research Institute for Climate Prediction (IRI), Lamont-Doherty Earth Observatory

THOUGHTS REGARDING PRESENTATIONS

These thoughts may assist you in assembling your presentations for the Symposium and Workshop on Climate to take place in September in Beijing, China. Please see the attached *Overview* for a description of the background and some expected outcomes of these meetings. The attached *Agenda* lists speakers and general presentation categories.

The audience for the Symposium is expected to be broad (e.g., meteorologists, climate scientists, oceanographers, and scientists interested in terrestrial atmospheric chemistry) while the Workshop may have a slightly larger proportion of its participants from the oceanographic community. Because we are seeking to impact China's research agenda in climate, we hope to be able to present our perspective on emerging topics in climate science, particularly those that will become important in the upcoming five-year period. Your presentation could summarize the state of scientific research or program activities in the overall subject area you are addressing, or you might talk about your current research and illustrate how you see this research evolving.

Here are some general suggestions:

- For the Symposium, a limited number of overheads (e.g., 4 or 5) to stimulate discussion with additional overheads for the discussion period may be very effective.
- The format for the Workshop will accommodate more detailed technical presentations.
- Base your presentation on your personal experience, but try to reflect the views of the scientific community you are representing.
- Try not to speak to Chinese applications or impacts; instead, speak to U.S. applications and impacts and allow the Chinese to interpret relevance for themselves.
- Speak openly and honestly about the degree of uncertainty in a particular field, if relevant to your topic area.

For the Climate Symposium (September 21 - 22) there will be five technical sessions, each with two U.S. and two Chinese speakers. Presentations will be approximately 15 minutes with another five minutes after each presentation for questions and answers. Thirty minutes are reserved for discussion at the end of each session. A moderator will facilitate this discussion which is open to the audience.

The format for the Workshop (September 23 - 24) is slightly different. There will be five technical sessions, each with one U.S. and one Chinese presenter. Presentations will last 25 minutes with another 15 minutes after each presentation for Q&A and discussion.